

LISTING OF CLAIMS**Claim 1 (currently amended)**

A device to measure individual or grouped cell voltages of a fuel cell stack having conductive areas to monitor fuel cell stack performance to provide diagnostic data, said device comprising:

a meter connected to individual or grouped cell conductive areas to measure the voltage and impedance of said individual or grouped cells changes in the measurement or the time response of the measurements; and

a monitor coupled to said meter to report on the performance of the fuel cell stack, such that the measurements of said individual or grouped cells are used to report on the performance of said fuel cell stack and further including a matrix array of opto isolators wherein no common ground is employed by the meter.

Claim 2 (cancel)**Claim 4 (currently amended)**

The device of Claim 2 55 wherein said microprocessor determines the performance of individual cells or cell groups based on the present operating current of the fuel cell stack.

Claim 5 (currently amended)

The device of Claim 2 55 wherein said microprocessor determines the performance of individual cells or cell groups based on measurements of the time response of the voltage of said individual cells or cell groups during a transient response caused by a high rate of change of fuel cell stack current.

Claim 6 (currently amended)

The device of Claim 2 55 wherein said microprocessor determines the performance of individual cells or cell groups based on measurements of the frequency response of the voltage of said individual cells or cell groups during a response caused by a periodic change of fuel cell stack current.

Claim 7 (currently amended)

The device of Claim 2 55 wherein said microprocessor determines the performance of individual cells or cell groups based on voltage measurements of said individual cells or cell groups in addition to at least one other fuel cell system parameter.

Claim 8 (currently amended)

The device of Claim 7 55 wherein said microprocessor determines the performance of individual cells or cell groups based on a logged history of voltage measurements of said individual cells or cell groups and other fuel cell system parameters.

Claim 9 (currently amended)

The device of Claim 2 55 wherein said microprocessor instructs a current load in communication with said microprocessor, electrically connected to said fuel cell stack, to provide a current load to the fuel cell stack in order to measure the voltage of individual cells or cell groups at various fuel cell stack operating currents.

Claim 13 (currently amended)

The device of Claim 2 55 wherein said microprocessor measures the contact resistance between electrical contacts of said contact assembly and said conductive areas of said individual cells or cell groups, to determine the condition of an poor electrical connection and potential false voltage reading.

Claim 14 (cancel)

Claim 16 (currently amended)

The device of Claim 2 55 wherein said meter further includes:

an electrical connection from said multiplexor output to allow connection of the multiplexor output signal to external measurement devices.

Claim 17 (cancel)

Claim 20 (currently amended)

The device of Claim 1, wherein said monitor:

displays present, minimum, maximum, and average voltages or impedance of individual cells or grouped cells or of performance parameters based on these voltages.

Claim 25 (currently amended)

A device to measure individual or grouped cell voltages of a fuel cell stack having conductive areas to monitor fuel cell stack performance to adjust fuel cell system operating parameters to optimize fuel cell stack performance and to maintain safe operating conditions:

a meter connected to individual or grouped cell conductive areas to measure the voltage or impedance of said individual or grouped cells and further including a matrix array of opto isolators to eliminate the need for a common ground; and

a controller coupled to with or comprised in part of said meter to adjust fuel cell system operating parameters,

such that the measurements of said individual or grouped cells are used to adjust fuel cell system operating parameters to optimize fuel cell stack performance and to maintain safe operating conditions.

Claim 26 (cancel)

Claim 30

The device of Claim 26 ~~58~~ wherein said microprocessor determines the performance of individual cells or cell groups based on measurements of the time response of the voltage of said individual cells or cell groups during a transient response caused by a high rate of change of fuel cell stack current.

Claim 31

The device of Claim 26 ~~58~~ wherein said microprocessor determines the performance of individual cells or cell groups based on measurements of the frequency response of the voltage of said individual cells or cell groups during a response caused by a periodic change of fuel cell stack current.

Claim 33 (currently amended)

The device of Claim 32 ~~58~~ wherein said microprocessor determines:

the performance of individual cells or cell groups based on voltage measurements of said individual cells or cell groups in addition to at least one other fuel cell system parameter;
and,

the performance of individual cells or cell groups based on a logged history of voltage measurements of said individual cells or cell groups and other fuel cell system parameters.

Claim 34

The device of Claim 26 ~~58~~ wherein said microprocessor instructs a current load in communication with said microprocessor, electrically connected to said fuel cell stack, to provide a current load to the fuel cell stack in order to measure the voltage of individual cells or cell groups at various fuel cell stack operating currents.

Claim 38

The device of Claim 26 ~~58~~ wherein said microprocessor measures the contact resistance between electrical contacts, of said contact assembly and said conductive areas of said

individual cells or cell groups, to determine the condition of an poor electrical connection and potential false voltage reading

Claim 39

The device of Claim ~~25~~ 58 further including:

one or more additional meters to allow the measurement of voltages of additional individual cells or grouped cells connected to said meter.

Claim 40 (currently amended)

The device of Claim 25, wherein said meter provides electrical isolation including opto isolators between individual cells or grouped cells connected thereto and external electrical connections of said meter

Claim 41

The device of Claim ~~26~~ 58, wherein said meter further includes an electrical connection from said multiplexor output to allow connection of the multiplexor output signal to external measurement devices.

Claim 52

The device of Claim ~~2~~ 55, wherein said contact assembly a plurality of electrical connections positioned at a plurality of points around the perimeter of said individual or grouped cells.

Claim 55 (new)

A device to measure individual or grouped cell voltages of a fuel cell stack having conductive areas to monitor fuel cell stack performance to provide diagnostic data, said device comprising:

a meter connected to individual or grouped cell conductive areas to measure the voltage of said individual or grouped cells; and

a monitor coupled to said meter to report on the performance of the fuel cell stack such that the measurements of said individual or grouped cells are used to report on the performance of said fuel cell stack wherein said meter further includes

a contact assembly associated with said individual or grouped cell conductive areas, wherein said contact assembly is electrically connected to said individual or grouped cell conductive areas; and

a multiplexer to switch between electrical connections of individual or grouped cells establishing an electrical signal path from an individual cell or group of cells; and,

an attenuator/amplifier to attenuate or amplify said electrical signal from said multiplexer; and,

a converter to convert the electrical signal from said attenuator/amplifier from an analog signal to a digital signal; and,

a microprocessor to read and interpret said digital signal, and

wherein said microprocessor communicates the measurement value or any diagnostic data based on said measurement to said monitor.

Claim 56 (new)

A device to measure individual or grouped cell voltages of a fuel cell stack having conductive areas to monitor fuel cell stack performance to provide diagnostic data, said device further including:

one or more additional meters connected to said meter to allow the measurement of voltages of additional individual cells or grouped cells further including

a meter connected to individual or grouped cell conductive areas to measure the voltage of said individual or grouped cells; and

a monitor coupled to said meter to report on the performance of the fuel cell stack such that the measurements of said individual or grouped cells are used to report on the performance of said fuel cell stack.

Claim 57 (new)

A device to measure individual or grouped cell voltages of a fuel cell stack having conductive areas to monitor fuel cell stack performance to provide diagnostic data, said device wherein said meter further includes:

a voltage or current excitation source in electrical connection with said multiplexer and temperature sensing devices to provide for a method to allow compatibility with temperature sensing devices to allow multiple point temperature measurements

wherein said meter is connected to individual or grouped cell conductive areas to measure the voltage of said individual or grouped cells; and

a monitor coupled to said meter to report on the performance of the fuel cell stack such that the measurements of said individual or grouped cells are used to report on the performance of said fuel cell stack.

Claim 58 (new)

A device to measure individual or grouped cell voltages of a fuel cell stack having conductive areas to monitor fuel cell stack performance to adjust fuel cell system operating parameters to optimize fuel cell stack performance and to maintain safe operating conditions:

a meter connected to individual or grouped cell conductive areas to measure the voltage of said individual or grouped cells; and

a controller coupled to with or comprised in part of said meter to adjust fuel cell system operating parameters,

such that the measurements of said individual or grouped cells are used to adjust fuel cell system operating parameters to optimize fuel cell stack performance and to maintain safe operating conditions;

a contact assembly associated with said individual or grouped cell conductive areas, wherein said contact assembly is electrically connected to said individual or grouped cell conductive areas; and,

a multiplexer to switch between electrical connections of individual or grouped cells establishing an electrical signal path from an individual cell or group of cells; and,

an attenuator/amplifier to attenuate or amplify said electrical signal from said multiplexer; and,

a converter to convert the electrical signal from said attenuator/amplifier from an analog signal to a digital signal; and,

a microprocessor to read and interpret said digital signal,

wherein said microprocessor communicates the measurement value or any evaluations based on said measurement to said controller.

Claim 59 (new)

A device to measure individual or grouped cell voltages of a fuel cell stack having conductive areas to monitor fuel cell stack performance to provide diagnostic data, said device wherein:

impedance is measured more accurately by using current measurements synchronized to the cell multiplexing.